
Space Weather Technical Forecast

Issued on Wednesday 11 December 2024 at 01:19 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Low to Moderate Solar Activity

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with four M-class flares observed, mainly originating from the newly numbered region, AR3922 in the southeast. With a peak flare of M6.4 at 10/0648 UTC. While AR3922 is currently the most active of the seven regions currently on the disc, it remains a small and apparently simple region, although this is still difficult to assess due to its location. AR3912 has now rotated of the western limb, but still brings the potential for some flare activity. AR3917 in the centre disc is the largest region, but remains relatively inactive, while AR3920 in the northeast has shown some increasing penumbra extent and complexity, but also remains relatively inactive. The other regions are currently small and simple.

No Earth directed CMEs were observed, with the CMEs from the M-class flares directed away from Earth.

Solar Wind / Geomagnetic Activity: Fast winds from CH98/+ very gradually faded through the period. Solar wind speeds, observed at L1 by ACE and DSCOVR eased from slightly elevated levels of around 500 km/s to be largely slow 370-400km/s. Density was initially average, falling to below average. Interplanetary Magnetic Field (Bt) stayed steady in the weak range, around 5-6nT. The north-south component (Bz) fluctuated between negative (southwards) and positive (northwards), -6 to +4nT throughout. The Phi angle was mainly positive (away from the Sun), except for a briefly negative interval between 10/0500 and 10/0700 UTC. Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was initially at background, rising to moderate in the diurnal cycle. The associated 24-hour fluence was below Active, with the 11/0000 UTC observation of 7.44e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Isolated M-class flares are likely, with a slight chance of X-class flares on Day 1 (11 Dec) becoming a chance of isolated M-class flares from Day 2 (12 Dec).

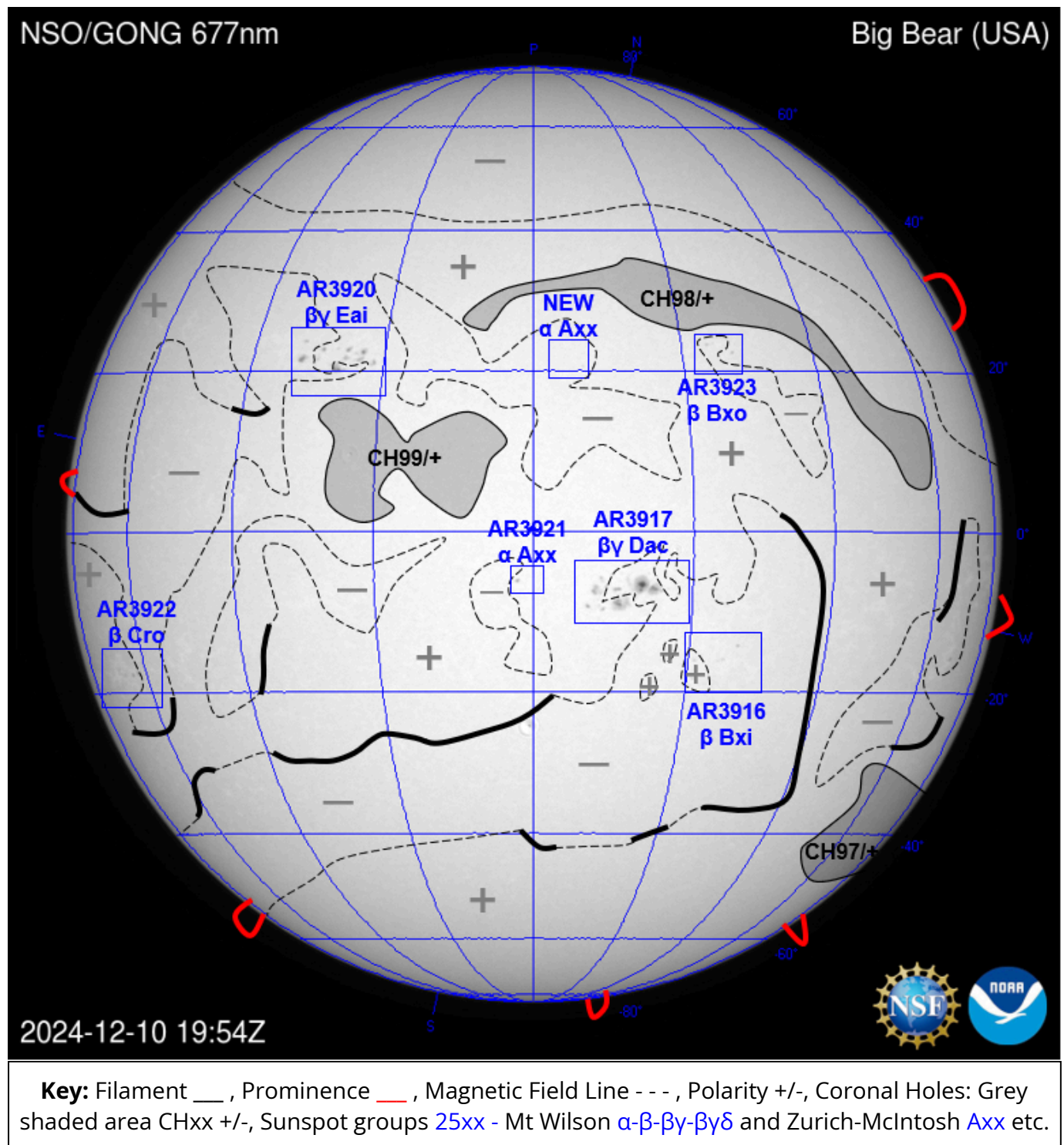
Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs. Influence of CH98 fast winds will continue to recede with solar winds likely easing to be background, but with brief

periods at slightly elevated remaining possible. Fast winds from CH99 may bring some enhancement to the solar wind from Day 3 (13 Dec).

Geomagnetic activity is forecast to be Quiet with isolated Unsettled intervals. By Day 3 (13 Dec), a chance of isolated Unsettled to Active intervals due to enhancement from CH99.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain at background with only a very slight chance of rising in response to any notable flares, initially most likely from AR3912 but with an increasing potential from AR3917. High energy electron flux is expected to persist at background, with a chance of moderate spells each day, with the 24-hour fluence remaining below the Active threshold.

Figure 1: Solar Synoptic Map valid 10/1954 UTC



Geomagnetic Storms

There are currently no Earth-directed CMEs.

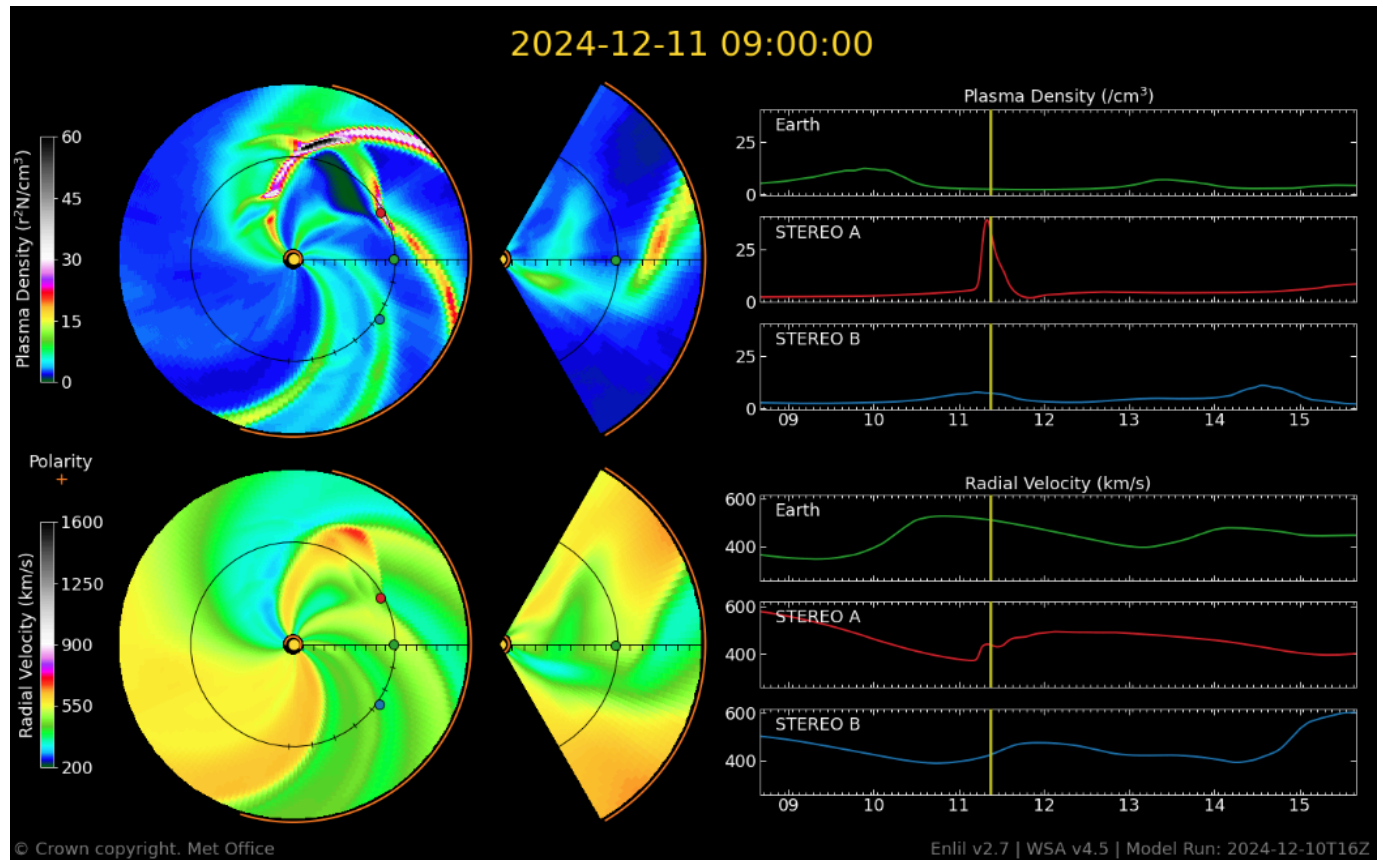
Fast winds from the connection to CH98 look to have largely passed with solar winds continuing to ease to mainly background speeds. While CH98 is extended eastward across the disc, it is now believed to be too far north to cause any significant enhancement, with any interactions expected to be minimal. The next enhancement is expected from CH99, which is currently just east of the centre disc. Any increase in solar winds from the connection to the fast winds of CH99 is forecast to be from Day 3 (13 Dec), with winds on the previous rotation reaching 480km/s. On the previous rotation, we saw no more than isolated Active geomagnetic spells which is likely to be similar this time around with only a very slight chance of G1/Minor storms if we see any prolonged negative Bz spells.

MOSWOC Enlil is initially poor, with the model showing winds speeds higher than reality. However, the onset of any HSS from CH99 appears reasonable, indicated as occurring by Day 3 (13 Dec).

Mainly Quiet geomagnetic activity is expected with a slight chance of isolated Unsettled spells at first. By Day 3 (13 Dec), a chance of isolated Unsettled to Active intervals due to enhancement from CH99 and a very slight chance of G1/Minor storms.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil output. Wind speeds currently too fast in Enlil compared to reality, but shows the easing trend before increase again from Day 3 (13 Dec).



Radio Blackouts - X-Ray Flares

There are seven sunspot regions currently on the Earth-facing disc. AR3912, the source of the X-class flare on 08 Dec has now rotated off the western limb, but still possesses a flare risk for the next 24 hours. AR3917 currently the largest region, situated in the centre southern disc, has been showing some slight simplification with spreading of its component spots. Meanwhile, AR3920 in the northeast, has shown growth and become increasingly complex with the development of some negative spots to the south of the leading positive spots, along with increasing penumbral extent. AR3922 has been the source for most of the M-class flares in the last 24 hours and although appears relatively simple in the current imagery, it is hard to identify its full magnetic complexity due to its oblique viewing angle. A few earlier small unnumbered regions have faded, apart from the newly numbered AR3923 in the northwest and a small Axx region in the northern centre disc.

Overall, this sees further isolated M-class flares likely, with a slight chance of X-class flares on Day 1 (11 Dec) becoming a chance of isolated M-class flares from Day 2 (12 Dec).

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	60	50	50	50
Very Active	R3-R5 (X Class)	No	10	5	5	5

Figure 3: GOES-16 SUVI 094 at 10/0644 showing flare from AR3922.

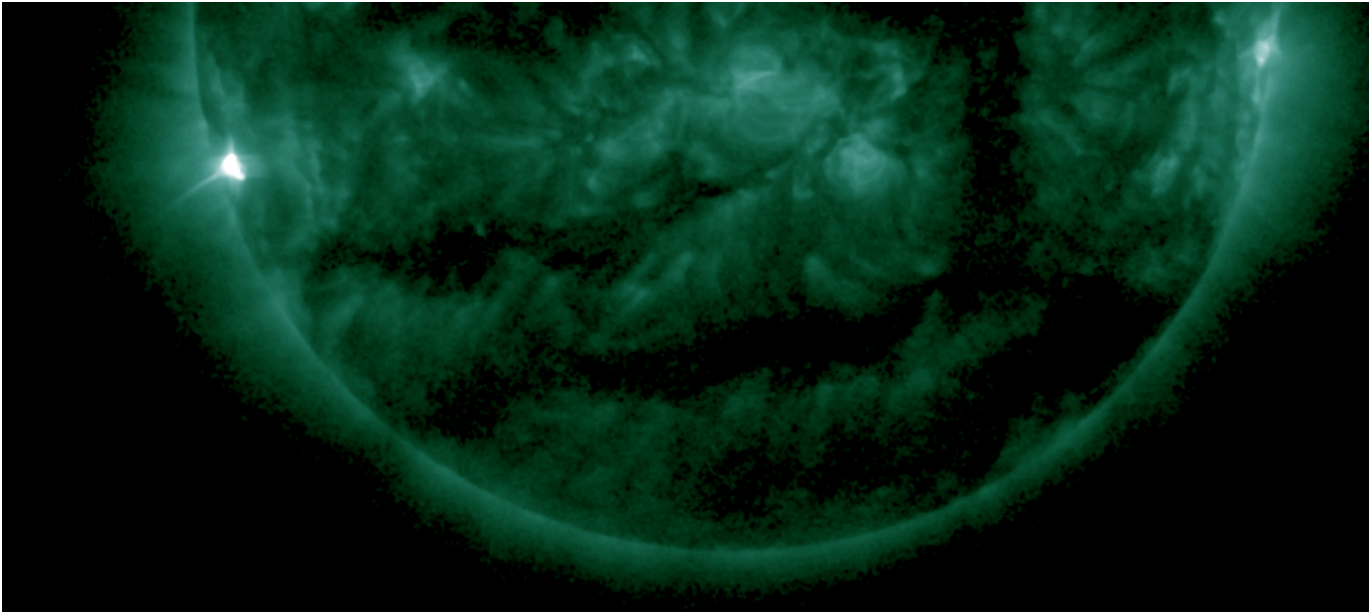
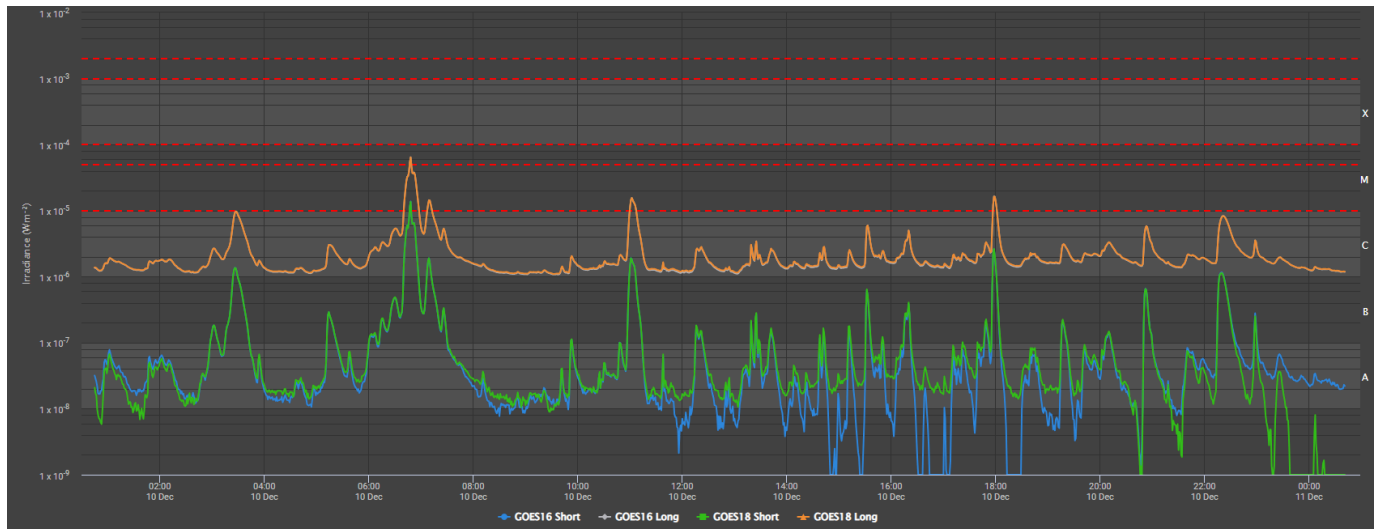


Figure 4: GOES16&18 X-ray flares. Four M flares, the strongest a M6.4 at 10/0648 UTC. Most M-class flares from AR3922.



Solar Radiation Storms (High Energy Protons)

GOES18 proton flux is currently at background, and is expected to persist at this level, with only a very slight chance of rising in response to any notable flares. With western disc solar flares more likely to produce observable protons, the main risk is currently from AR3912, the source of the X-class flare on 08 Dec. This will soon rotate off the west limb, however there are a number of other regions on the disc, including AR3917 in the centre disc, which will then move into a slightly more prone location.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy Electron flux observed by GOES16 showed a diurnal increased from background levels to moderate with a similar trend likely to continue. Recent solar wind enhancement from the fast wind of CH98 was relatively subdued with its geoeffective nature, despite peaking at around 500 km/s. This likely limited the charging of the Van Allen Belts, and any subsequent electron flux that will be observed through this period. Subsequently mainly background flux is expected but likely peaking moderate at diurnal peak. No further notable enhancements are currently forecast.

The associated 24 hr fluence is expected to remain below the Active level. While MOSWOC REFM forecast fluence is currently underdone, it is expected to come back in to line to provide reasonable guidance.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM output.

